

a data generator aligning phases of a first predetermined number of data on a corresponding number of channels and adding a second predetermined number of error correction bits to said first predetermined number of data, said second predetermined number of error correction bits being in parallel with said first predetermined number of data; and

a wavelength-multiplexor, connected to the data generator, converting each of said first predetermined number of data and said second predetermined number of error correction bits to respective optical signals having different wavelengths and wavelength-multiplexing said optical signals so as to be delivered to the optical transmission line.

29. (AS ONCE AMENDED HEREIN) An optical transmission system as recited in claim 27, wherein the receiving-end device comprises:

a wavelength-demultiplexor separating the wavelength-multiplexed optical signals from the optical transmission line into further optical signals, each corresponding to one of the different wavelengths; and

a data regenerator, connected to the wavelength-multiplexor, regenerating said first predetermined number of error corrected data, derived from a third number of further data contained in said further optical signals using said second predetermined number of error correction bits contained in said further optical signals, the third number being equal to the first number.

REMARKS

In accordance with the foregoing, the claims have been amended to clarify certain salient features of the invention and to improve form. No new matter is presented. Approval and entry of the amended claims are respectfully requested.

ITEMS 1 AND 2: RESTRICTION REQUIREMENT MADE FINAL AND CLAIMS 2-20 ARE WITHDRAWN

Reconsideration is respectfully requested.

It is respectfully submitted that the Examiner's response to applicant's traversal of the election requirement, at page 2, item 1 of the Action, is illogical:

The traversal is on the ground(s) that Species 1 (claims 1, 21-27) are generic to all pending claims. This is not found persuasive because e.g., Figure 2 illustrates a phase alignment (6) element that is not generic to all claims.

The requirement is still deemed proper and is therefore made FINAL.

It is respectfully submitted that the assertion that "Figure 2 illustrates a phase alignment (6) element that is not generic to all claims" is meaningless. "Generic" relates to claims, not elements of a figure.

Applicant's counsel contacted the Examiner in early January, 2003 regarding the grounds asserted by the Examiner in item 1 of the Action, and he agreed to discuss the alleged deficiencies of same with his supervisor and then to contact applicant's undersigned counsel on Thursday, January 9, 2003. No such return telephone call was ever received. Applicant's counsel would still appreciate having such a telephone conference with the Examiner.

Nevertheless, it is submitted that the grounds advanced to support the restriction requirement are self-evidently defective and fail to support same, much less render the same FINAL.

Claims 21-27, moreover, are submitted clearly to be generic to at least all of Figs. 2, 5, 8 and 9.

For the convenience of the Examiner, applicants have set forth in the following table the species as now correctly identified by the Examiner in the October 23, 2002 Office Action, for each "Species Group" along with the corresponding "Figure" and the respective System, Transmit and Receive Claims.

Species Group	Figure	System Claims	Transmit Claims	Receive Claims
1	2	1, 21, 24, 27	22, 25	23, 26
2	5	2	9	10
3	7		7	8
4	8	--	5	6

5	9	3	11	12
6	10	4	13	14
7	11	--	15	16
8	12		17	18
9	13	--	19	20

The structures of Figs. 2, 5, 8 and 9 include many common elements, as is readily seen from those figures, and which are generically encompassed within the scope of at least one or more of the respective independent claims correlated with the aforesaid figures 2, 5, 8 and 9, as set forth in the above table.

The foregoing amendments to the specification at pages 10, 11 and 14, moreover, relate the generic terminology of these claims to the disclosed structures of Figs. 2, 5, 8, and 9 and which clearly establish the generic scope of the independent claims 1 and 21-27 relative to the specified figures.

Accordingly, it is respectfully requested that the Species Groups 1, 2, 4, and 5 corresponding to Figs. 2, 5, 8, and 9 and the respective claims which read thereon, as set forth in the above table, be included for examination herein.

ITEM 3: DRAWINGS

In response to the objection to the drawings in item 3 of the Action, corrected and formal drawings are filed concurrently in a separate Letter to the Examiner Requesting Approval of Changes and Entry of Corrected Formal Drawings.

ITEMS 4-6: REJECTIONS OF CLAIMS FOR INDEFINITENESS UNDER 35 USC § 112, ¶ 2

It is respectfully submitted that the grounds of alleged indefiniteness of the aforesaid claims are overcome by the foregoing amendments to same.

ITEMS 7 AND 8: REJECTION OF CLAIMS 1 AND 21-29 FOR OBVIOUSNESS UNDER 35 USC § 103(a) OVER ROBERTS ET AL., USP 6,313,932, IN VIEW OF ALEXANDER ET AL., USP 5,784,184

The rejections are respectfully traversed.

Roberts et al. USP 6,313,932 B1 discloses a method of optical communication in which error correction coding is applied to data carried by channels using both interchannel coding and serial coding of individual channels. The resulting code word of N bits is transmitted to the modulator array, thereby allowing the entire code word to be transmitted in a single pulse. The number of modulating elements forming the modulator array 5 is therefore required to be greater than $N=n+n_e$, where N_e is equal to the number of parity bits added by the error coding. A transmitter sends signals through free space to a receiver. The receiver demodulates the signals to derive data streams from the signals where the number of the data streams is greater than the number of the code words. Then the receiver selects a predetermined number of the data streams associated with less, i.e., reduced, error rates where the predetermined number is equal to the number of the code words. In this way, a reliable data transmission can be achieved in Roberts.

Alexander et al. USP 5,784,184 discloses an optical-WDM transmission system sending signals via fiber, in which an FEC is employed in order to improve reliability.

It is apparent that the multiplexed transmission in Roberts applies error correction coding on the basis of a frame, which has been generated by using serial coding for each of plural channels or by using a plurality of transmission channels as shown in Fig. 11. That is to say, the frame has to be generated.

On the contrary, an optical transmission system according to the present invention forms k data by aligning phases of data on k channels with each other before generating $(n-k)$ error correction bits for the k data. Aligning of the phases of the data means that transition points of the data are coincident with each other. Then, the $(n-k)$ error correction bits are added to the k data comprising the parallel channels and n optical signals converted from k data and $(n-k)$ error correction bits are transmitted and a reliable data transmission can be achieved without forming a frame.

Since the optical transmission system of the present invention can correct errors without using the frame, a memory space and a delay caused by the time required for storing the data

of a size of the frame can be saved.

Error correction entails a reception of error correction code words including data to be transmitted, a localization of a bit position where the error has occurred, and a correction of the error. Therefore, if the frame is used in the error correction, as described in Roberts, the reception of one frame would result in at least use of memory space and a time delay for receiving and storing the data corresponding to the frame. The present invention can alleviate this drawback by applying error correction to the bits within the concurrent channels.

Neither of Roberts and Alexander teaches or indicates that error correction is applied to the bits within the concurrent channels. Both of them deal with error correction on the basis of a frame.

For the foregoing reasons, it is submitted that the pending claims patentably distinguish over the references taken singly or in any proper combination.

CONCLUSION


There being no other objections, it is submitted that the pending application is in condition for allowance, which action is earnestly solicited.

If there are any additional fees associated with filing of this Amendment, please charge the same to our Deposit Account No. 19-3935.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE**IN THE SPECIFICATION:**

Please AMEND the paragraph beginning at page 2, line 18, as follows:

The wavelength demultiplexer [202] 207 at the optical receiver 202 separates the multiplexed signals received from the optical transmitter 201 through the optical transmission line 203 into the signals corresponding to the wavelengths λ_1 to λ_k , respectively. These optical signals having the wavelength of λ_1 to λ_k , respectively, are converted to corresponding electrical signals by the optical-electrical converter 208, and then the SOH of the electrical signals is terminated by the SOH terminating unit 209. The electrical signals having their SOH [been] terminated are transmitted to a further stage (not shown in Fig. 1) on an each (i.e., individual) channel basis. Thus, the data comprising the electrical signals for each of the channels CH_1 to CH_k can be transmitted from the optical transmitter 201 to the optical receiver 202 over the signal optical transmission line 203.

Please AMEND the paragraph beginning at page 3, line 27, as follows:

Furthermore, in some of the conventional transmission systems, erroneous bits included in the transmission data cannot be corrected when parity bits are contained in the data. One solution for improving a capability of correcting the erroneous bits in the data is to increase the number of the error correction bits added to the transmission data. However, this solution may be not practical, because a considerably high transmission rate is required for increasing the number of error correcting redundant bits to be added to the transmission data.

Please AMEND the paragraph beginning at page 4, line 1, as follows:

Another possible solution is to insert the error correction bits into reserved bits within the SOH. The reserved bits means that those bits are reserved for a variety of future applications. In this case, since a lot of redundant bits are to be inserted into some particular locations in the SOH, a problem may occur that a size of a circuit comprising a transmission device, such as the transmitter 201 and the receiver 202, is enlarged. This solution has a further drawback in that the error correction bits, which have been already assigned to the reserved bits, cannot be made use of, if the reserved bits are decided to be used for one of the future applications.

Please AMEND the paragraph beginning at page 10, line 2, as follows:

The transmitting-end station 1 further includes the phase alignment unit 6 that is connected to the encoder 5 and which together performs a data generating function. The encoder 5 provides a signal of all n bits comprising the k data from the channels and the generated $(n-k)$ error correction bits to the phase alignment unit 6. The phase alignment unit 6 compensates for a delay due to the error correction coding so as to phase all the n bits. The phase alignment unit 6 may be, for example, a delay circuit capable of aligning a delay time appropriately. The signals comprising the n bits in phase are then passed to the electrical-optical converter 7, which is also included in the transmitting-end station 1. The electrical-optical converter 7 converts the electrical signals of the n bit into optical signals having wavelengths λ_1 to λ_n , respectively.

Please AMEND the paragraph beginning at page 11, line 20, as follows:

The electrical signals received by the decoder 13 are formed by k bits, each corresponding to one of the channels CH_1 to CH_k , and $(n-k)$ error correction bits. Then the decoder 13 performs a data regenerating function, which includes error correction decoding by means of the k bits representing the data from the channels CH_1 to CH_k and the $(n-k)$ error correction bits and sends the decoded signals to the SOH termination unit 14, which is also included in the receiving-end station 2. The SOH termination unit 14 terminates the SOHs and delivers the signals with the SOHs to a succeeding device (not shown in Fig. 2) as data representing the data coming from the channels CH_1 to CH_k .

Please AMEND the paragraph beginning at page 14, line 12, as follows:

A second embodiment of an optical transmission system according to the present invention is shown in Fig. 5. As shown in Fig. 5, the optical transmission system comprises a transmitting-end station 21, a receiving-end station 22, an optical transmission line connecting the transmitting-end station 21 and the receiving-end station 22. The transmitting-end station 21 includes an SOH inserting unit 24, a parity generator 25, a phase alignment unit 26, an electrical-optical converter (OS) 27 and a wavelength-multiplexing unit 28. The receiving-end station 22 includes a wavelength-demultiplexing unit 31, an optical-electrical converter (OR) 32,

a parity detector 33, an SOH terminating unit 34 and an error correction unit. In Fig. 5, the encoding unit and its function, as in Fig. 2, are incorporated in the parity generator 25 and the decoding unit and its function, as in Fig. 2, are incorporated in the parity detector 33.

Please AMEND the paragraph spanning pages 14-15, as follows:

At the transmitting-end station 24, the SOH inserting unit 24 adds an individual SOH (Section Over Head) to each transmission data coming from k channels CH_1 to CH_k and supplies the k transmission data with the individual SOH to the parity generator 25. The parity generator 25 calculates a parity bit for the supplied k transmission data and outputs the calculated parity bit together with the k transmission data, and thus, passing (k+1) data to the phase alignment unit 26. The phase alignment unit 26 compensates for a delay caused by the parity generator 25 and sends resulting in-phase (k+1) data to the electrical-optical converter 27. The electrical-optical converter 27 converts the in-phase (k+1) data to (k+1) optical signals having different wavelengths λ_1 to λ_{k+1} and passes the optical signals to the wavelength-multiplexing unit 28. The wavelength-multiplexing unit 28 multiplexes the (k+1) optical signals and sends the multiplexed signals to the optical transmission line 23. In this case, the parity bit calculated for the k transmission data on the channels CH_1 to CH_k corresponds to the vertical parity.

Please AMEND the paragraph spanning pages 19-20, as follows:

The transmitting-end station 41 includes a frame generating and SOH inserting unit 44, an encoder 45, an electrical-optical converter (OS) 46 and a wavelength-multiplexing unit 47. The receiving-end station 42 includes a wavelength-demultiplexing unit 51, an optical-electrical converter (OR) 52, a memory unit 53, a decoder 54, an SOH terminating unit 55 and a top-of-frame ("TOF") detector 56.

Please AMEND the paragraph beginning at page 32, line 17, as follows:

The transmitting-end station 111 includes an encoder 114, an identification ("ID") signal-inserting unit 115, a multiplexing unit 116 and an electrical-optical converter (OS) 117. The receiving-end station 112, includes an optical-electrical converter (OR) 118, a separator 119, an identification ("ID") signal detector 120 and a decoder 121.

IN THE CLAIMS:

Please AMEND the following claims:

1. (TWICE AMENDED) An optical transmission system, comprising a transmitting-end optical transmission device, a receiving-end optical transmission device and an optical transmission line connecting the transmitting-end and receiving-end optical transmission devices,

the transmitting-end optical transmission device comprising:

encoding means, having n outputs, for forming k data by aligning phases of data on k channels with each other and for generating $(n-k)$ error correction bits for said k data and adding said $(n-k)$ error correction bits to said k data, said $(n-k)$ error correction bits being in parallel with said k data, and

wavelength-multiplexing means, connected to the encoding means, for converting both said k data and said $(n-k)$ error correction bits to n optical signals having different wavelengths and for wavelength-multiplexing said n optical signals so as to be delivered to the optical transmission line; and

the receiving-end optical transmission device comprising:

wavelength-demultiplexing means for separating the wavelength-multiplexed optical signals from the optical transmission line into n optical signals, each corresponding to one of the different wavelengths, and

decoding means connected to the wavelength-demultiplexing means, for generating k error corrected data by correcting error bits using the $(n-k)$ error correction bits contained in said n separated optical signals.

2. (ONCE AMENDED) An optical transmission system comprising a transmitting-end optical transmission device, a receiving-end optical transmission device and an optical transmission line connecting the transmitting-end and receiving-end optical transmission devices,

the transmitting-end optical transmission device comprising:

parity generating means for forming k data by adding an SOH (Section Over Head) including at least one error monitoring byte to data on k channels and aligning phases of said

data with each other and for generating a parity bit for said k data and adding said parity bit to said k data; and

wavelength-multiplexing means connected to the parity generating means, for converting said k data and said parity bit to $(k+1)$ optical signals having different wavelengths and for wavelength-multiplexing said $(k+1)$ optical signals so as to be delivered to the optical transmission line, and

the receiving-end optical transmission device comprising:

wavelength-demultiplexing means for separating the wavelength-multiplexed optical signals from the optical transmission line into $(k+1)$ optical signals, each corresponding to one of the different wavelengths; and

error correction means connected to the wavelength-demultiplexing means, for correcting error bits based on one result of a parity check for said separated $(k+1)$ optical signals and the other result of a parity check using said at least one error monitoring byte.

3. (ONCE AMENDED) An optical transmission system comprising a transmitting-end optical transmission device, a receiving-end optical transmission device and an optical transmission line connecting the transmitting-end and receiving-end optical transmission devices,

the transmitting-end optical transmission device comprising:

encoding means having k input and n outputs, for generating $(n-k)$ error correction bits for every transmission data having k bits; and

wavelength-multiplexing means connected to the encoding means, for converting said transmission data and said $(n-k)$ error correction bits to n optical signals having different wavelengths and for wavelength-multiplexing said n optical signals so as to be delivered to the optical transmission line, and

the receiving-end optical transmission device comprising:

wavelength-demultiplexing means for separating the wavelength-multiplexed optical signals from the optical transmission line into n optical signals, each corresponding to one of the different wavelengths; and

decoding means connected to the wavelength-demultiplexing means, for correcting error bits of data having k bits contained in said n separated optical signals by using said $(n-k)$ error correction bits contained in said n separated optical signals.



21. (ONCE AMENDED) An optical transmission system comprising a transmitting-end optical transmission device, a receiving-end optical transmission device and an optical transmission line connecting the transmitting-end and receiving-end optical transmission devices,

the transmitting-end optical transmission device comprising:

data generating means for aligning phases of a first predetermined number of data on a corresponding number of channels and for adding a second predetermined number of error correction bits to said first predetermined number of data, said second predetermined number of error correction bits being in parallel with said first predetermined number of data, and

wavelength-multiplexing means, connected to the data generating means, for converting [both] each of said first predetermined number of data and said second predetermined number of error correction bits to respective optical signals having different wavelengths and for wavelength-multiplexing said optical signals so as to be delivered to the optical transmission line; and

the receiving-end optical transmission device comprising:

wavelength-demultiplexing means for separating the wavelength-multiplexed optical signals from the optical transmission line into further optical signals, each corresponding to one of the different wavelengths, and

data regenerating means, connected to the wavelength-demultiplexing means, for regenerating said first predetermined number of error corrected data[, error corrected] by correcting error bits of a third [said first predetermined] number of further data, the third number being equal to the first number, contained in said further optical signals using said second [predetermined] number of error correction bits contained in said further optical signals.

22. (ONCE AMENDED) A transmitting-end optical transmission device in an optical transmission system comprising the transmitting-end optical transmission device, a receiving-end optical transmission device and an optical transmission line connecting the transmitting-end and receiving-end optical transmission devices, comprising:

data generating means for aligning phases of a first predetermined number of data on a

corresponding number of channels and for adding a second predetermined number of error correction bits to said first predetermined number of data, said second predetermined number of error correction bits being in parallel with said first predetermined number of data; and

wavelength-multiplexing means, connected to the data generating means, for converting [both] each of said first predetermined number of data and said second predetermined number of error correction bits to respective optical signals having different wavelengths and for wavelength-multiplexing said optical signals so as to be delivered to the optical transmission line.

23. (ONCE AMENDED) A receiving-end optical transmission device in an optical transmission system comprising a transmitting-end optical transmission device, the receiving-end optical transmission device and an optical transmission line connecting the transmitting-end and receiving-end optical transmission devices, comprising:

wavelength-demultiplexing means for separating the wavelength-multiplexed optical signals from the optical transmission line into further optical signals, each corresponding to one of the different wavelengths; and

data regenerating means, connected to the wavelength-demultiplexing means, for regenerating said first predetermined number of [data.] error corrected data by correcting [said first predetermined] error bits of a third number of further data, the third number being equal to the first number, contained in said further optical signals using said second [predetermined] number of error correction bits contained in said further optical signals.

24. (ONCE AMENDED) An optical transmission system comprising a transmitting-end optical transmission device, a receiving-end optical transmission device and an optical transmission line connecting the transmitting-end and receiving-end optical transmission devices,

the transmitting-end optical transmission device comprising:

a data generator aligning phases of a first predetermined number of data on a corresponding number of channels and adding a second predetermined number of error correction bits to said first predetermined number of data, said second predetermined number of error correction bits being in parallel with said first predetermined number of

data, and

a wavelength-multiplexor, connected to the data generator, converting [both] each of said first predetermined number of data and said second predetermined number of error correction bits to respective optical signals having different wavelengths and wavelength-multiplexing said optical signals so as to be delivered to the optical transmission line; and

the receiving-end optical transmission device comprising:

a wavelength-demultiplexor separating the wavelength-multiplexed optical signals from the optical transmission line into further optical signals, each corresponding to one of the different wavelengths, and

a data regenerator, connected to the [wavelength-multiplexing means] wavelength-demultiplexer, regenerating said first predetermined number of [data], error corrected data, derived from a third number [by said first predetermined number] of further data contained in said further optical signals using said second predetermined number of error correction bits contained in said further optical signals, the third number being equal to the first number.

25. (ONCE AMENDED) A transmitting-end optical transmission device in an optical transmission system comprising the transmitting-end optical transmission device, a receiving-end optical transmission device and an optical transmission line connecting the transmitting-end and receiving-end optical transmission devices, comprising:

a data generator aligning phases of a first predetermined number of data on a corresponding number of channels and adding a second predetermined number of error correction bits to said first predetermined number of data, said second predetermined number of error correction bits being in parallel with said first predetermined number of data; and

a wavelength-multiplexor, connected to the data generator, converting [both] each of said first predetermined number of data and said second predetermined number of error correction bits to respective optical signals having different wavelengths and wavelength-multiplexing said optical signals so as to be delivered to the optical transmission line.

26. (ONCE AMENDED) A receiving-end optical transmission device in an optical transmission system comprising a transmitting-end optical transmission device, the receiving-end optical transmission device and an optical transmission line connecting the transmitting-end and receiving-end optical transmission devices, comprising:

a wavelength-demultiplexor separating the wavelength-multiplexed optical signals from the optical transmission line into further optical signals, each corresponding to one of the different wavelengths; and

a data regenerator, connected to the [wavelength-multiplexing means] wavelength-demultiplexor, [for] regenerating said first predetermined number of error-corrected data, [error corrected by said first predetermined number] derived from a third number of further data contained in said further optical signals using said second predetermined number of error correction bits contained in said further optical signals, the third number being equal to the first number.

27. (AS UNAMENDED) An optical transmission system wherein wavelength multiplexed optical signals are transmitted over an optical transmission line, as produced by a transmission-end device for such transmission, or, after such transmission, as received by a receiving-end device, wherein:

the transmitted wavelength multiplexed optical signals comprise a first predetermined number of data on a corresponding number of channels having added thereto a second predetermined number of error correction bits and both thereof converted to optical signals of respective, different wavelengths and which are wavelength-multiplexed for such transmission.

28. (ONCE AMENDED) An optical transmission system as recited in claim [24] 27, wherein the transmission-end device comprises:

a data generator aligning phases of a first predetermined number of data on a corresponding number of channels and adding a second predetermined number of error correction bits to said first predetermined number of data, said second predetermined number of error correction bits being in parallel with said first predetermined number of data; and

a wavelength-multiplexor, connected to the data generator, converting [both] each of said first predetermined number of data and said second predetermined number of error

correction bits to respective optical signals having different wavelengths and wavelength-multiplexing said optical signals so as to be delivered to the optical transmission line.

29. (ONCE AMENDED) An optical transmission system as recited in claim [24] 27, wherein the [transmission-end] receiving-end device comprises:

a wavelength-demultiplexor separating the wavelength-multiplexed optical signals from the optical transmission line into further optical signals, each corresponding to one of the different wavelengths; and

a data regenerator, connected to the [wavelength-multiplexing means] wavelength-multiplexer, [for] regenerating said first predetermined number of error corrected data, [error corrected by said first predetermined number of] derived from a third number of further data contained in said further optical signals using said second predetermined number of error correction bits contained in said further optical signals, the third number being equal to the first number.